

WHAT IS CLAIMED IS:

- 1 1. A combustion control system for a spark ignition internal combustion
2 engine, the system being configured to:
 - 3 detect engine operating conditions;
 - 4 predict, based on the detected engine operating conditions, autoignition
5 timing of an end gas and an amount of heat released due to autoignition of the end
6 gas; and
 - 7 control combustion to establish such a relationship between the
8 autoignition timing and the amount of heat released due to the autoignition as to
9 give a knock intensity not higher than a specified intensity limit.
- 1 2. A combustion control system according to Claim 1, wherein the knock
2 intensity is calculated such that the knock intensity increases as the amount of
3 heat released due to the autoignition is increased and as the autoignition timing is
4 advanced.
- 1 3. A combustion control system according to Claim 2, wherein the knock
2 intensity is calculated such that the knock intensity increases with engine speed.
- 1 4. A combustion control system according to Claim 1, wherein the specified
2 intensity limit corresponds to a trace knock level.
- 1 5. A combustion control system according to Claim 1, wherein the
2 combustion is controlled by adjusting ignition timing.
- 1 6. A combustion control system according to Claim 1, wherein the
2 autoignition timing and the amount of heat released due to the autoignition are
3 predicted by estimating an ignition delay of the end gas.
- 1 7. A combustion control system according to Claim 1, wherein the

2 occurrence of the autoignition is predicted by integrating the inverse of an ignition
3 delay of the end gas to estimate the autoignition timing and the amount of heat
4 released due to the autoignition.

1 8. A combustion control system according to Claim 1, wherein the
2 occurrence of the autoignition is predicted by an elementary reaction model to
3 estimate the autoignition timing and the amount of heat released due to the
4 autoignition.

1 9. A combustion control system for a spark-ignition internal combustion
2 engine, the system being configured to:

3 detect engine operating conditions;
4 predict, based on the detected engine operating conditions, an
5 autoignition timing of an end gas and an amount of heat released due to
6 autoignition of the end gas;
7 calculate a knock intensity from the autoignition timing and the amount
8 of heat released due to the autoignition; and
9 control combustion in the engine in such a manner that the knock
10 intensity is lower than or equal to a specified intensity limit.

1 10. A combustion control system according to Claim 9, wherein the knock
2 intensity is calculated such that the knock intensity increases as the amount of
3 heat released due to the autoignition is increased and as the autoignition timing is
4 advanced.

1 11. A combustion control system according to Claim 10, wherein the knock
2 intensity is calculated such that the knock intensity increases with engine speed.

1 12. A combustion control system according to Claim 9, wherein the specified
2 intensity limit corresponds to a trace knock level.

1 13. A combustion control system according to Claim 9, wherein the
2 combustion is controlled by adjusting ignition timing.

1 14. A combustion control system according to Claim 9, wherein the
2 autoignition timing and the amount of heat released due to the autoignition are
3 predicted by estimating an ignition delay of the end gas.

1 15. A combustion control system according to Claim 9, wherein the
2 occurrence of the autoignition is predicted by integrating the inverse of an ignition
3 delay of the end gas to estimate the autoignition timing and the amount of heat
4 released due to the autoignition timing.

1 16. A combustion control system according to Claim 9, wherein the
2 occurrence of the autoignition is predicted by an elementary reaction model to
3 estimate the autoignition timing and the amount of heat released due to the
4 autoignition.

1 17. A combustion control method for a spark-ignition internal combustion
2 engine, comprising:
3 detecting engine operating conditions;
4 predicting, based on the detected engine operating conditions,
5 autoignition timing of an end gas and an amount of heat released due to
6 autoignition of the end gas; and
7 controlling combustion to establish such a relationship between the
8 autoignition timing and the amount of heat released due to the autoignition as to
9 give a knock intensity not higher than a specified intensity limit.

1 18. A combustion control method according to Claim 19, further comprising:
2 computing an engine torque while calculating the knock intensity; and
3 determining trace knock ignition timing and MBT ignition timing based
4 on the knock intensity and the engine torque,

5 wherein said controlling includes setting spark ignition timing to either
6 one of the MBT ignition timing and the trace knock ignition timing located on a
7 retard side.

1 19. A combustion control method according to Claim 19, wherein the knock
2 intensity is calculated such that the knock intensity increases as the amount of
3 heat released due to the autoignition is increased, as the autoignition timing is
4 advanced and as engine speed is increased.

1 20. A combustion control method for a spark-ignition internal combustion
2 engine, comprising:

3 detecting engine operating conditions;
4 predicting, based on the detected engine operating conditions,
5 autoignition timing of an end gas and an amount of heat released due to
6 autoignition of the end gas;
7 calculating a knock intensity from the autoignition timing and the amount
8 of heat released due to the autoignition; and
9 controlling combustion in the engine in such a manner that the knock
10 intensity is lower than or equal to a specified intensity limit.

1 21. A combustion control method according to Claim 20, further comprising:
2 computing an engine torque while calculating the knock intensity; and
3 determining trace knock ignition timing and MBT ignition timing based
4 on the knock intensity and the engine torque,
5 wherein said controlling includes setting spark ignition timing to either
6 one of the trace knock ignition timing and the MBT ignition timing located on a
7 retard side.

1 22. A combustion control method according to Claim 20, wherein the knock
2 intensity is calculated such that the knock intensity increases as the amount of
3 heat released due to the autoignition is increased, as the autoignition timing is

4 advanced and as engine speed is increased.